

**TEST REPORT**

**COMPRESSIVE TESTING OF SILFLEX WALKWAY SHIELDING  
USING IRON AND POLYMER CASTERS**

**American Ceramic Technology, Inc.**

**Laboratory Tests**

**March 2016**

### **Test Objective**

To determine the degree of penetration of casters into Silflex walkway shielding by mechanically loading casters and determining elastic deformation of Silflex and whether edges of casters cut Silflex during heavy loading

### **Testing Technique**

Test Silflex pieces were supported during testing on two different surfaces:

- 1) Solid Steel Plate
- 2) Steel Floor Grating having cross bars on top side of grating in contact with Silflex “bottom” surface. Grating openings were 4” X 1” with blades being 1.25” high. (Grating was used to see whether forcing Silflex into grate openings “cut” the bottom surface of Silflex.)

### **Loading of Test Silflex and Casters**

A photo that follows shows the stacking sequence of components for loading. The load cell of the Instron load frame contacted the caster being tested which in turn contacted the Silflex member, all of which rested on the lower support (solid steel block or walkway grate.) Mechanical loading was accomplished on an Instron screw-driven load frame equipped with a calibrated load cell to sense compression of the caster “wheel” into the Silflex surface (in inches) as a function of load (in pounds force). The Instron was set to load all samples at the same rate of 1000 pounds force per minute. Load was taken to a desired maximum and then the testing was stopped. The maximum loading was typically between 1000 and 1500 pounds (translating to the situation of having a cart with 4 casters loaded with 4000-6000 pounds.) Photos were taken during the loading procedures. The photos show the penetration of casters into the surface of Silflex. When load was removed, samples were checked for permanent deformation of Silflex (in the form of an indentation or impression in the Silflex’s surface that could be seen by eye.)

### **Silflex Samples**

A set of four (4) different samples comprising either a monolithic composition or a layered compositional structure was used. (Note: 1) The same single Silflex samples were used for all the tests reported for that construction. 2) Because of concern about possible cutting of the Silflex by floor grate “blades”, all tests using solid steel support were done before samples were used in grate-support testing.

Silflex samples tested are given in the following list. It should be noted that the upper surface of Silflex samples (surface that contacted caster was the customary yellow silicone-only thin layer, typically 0.125" thick, that is common to most Silflex walkway sheets.

### **Silflex Walkway Shielding Sample Descriptions**

- 1) 1.125" thick (73 w/o) Iron Silflex
- 2) 0.5" thick (90 w/o) Tungsten Silflex
- 3) 0.5" (87.5 w/o) Bismuth Silflex
- 4) Upper layer 1.0" Iron Silflex ; Lower layer 0.125" (84 w/o) Magnetic Silflex

NOTE: All samples were 5" x 5" squares having the uppermost layer that contacted a caster being yellow silicon elastomer of 0.125" thickness. The yellow surfaces were covered with formed-in small elliptical shaped non-skid texturing. While the yellow does not contain radiation attenuating material, it is continuously and homogeneously well-bonded to the underlying bulk Silflex attenuating composition.

### **Caster Wheels Pressed Into Silflex**

Casters tested were of two compositions. 1) Cast iron, and 2) molded polyurethane with each used in two diameters; namely 6" and 8". All casters used had 2" wide tread surface that was slightly radiused on both edges by the manufacturer so that the edge of the penetrating wheel was not a "sharp 90 degree edge. The polymer wheel casters were molded with an approximate 1/8" crown that was centered on the wheel width.

### **Testing Sequences: Samples, Casters, Sizes and Caster Type**

The testing sequence of Samples was 2, --3,--1, --4.

Each sample was sequenced through the caster set in the order: 8" Polymer, 6" Polymer, 8" Iron and 6" Iron

Note: The sequencing of samples and casters was organized with the intention of going from mild to harsh conditions as imagined by the tester.

### **Data Measurements and Observations**

Stress-strain plots were made and printed from Instron data. Stress-strain plots allow one to easily see whether deformation is primarily elastic or some combination of elastic and plastic. Elastic deformation of Silflex was indicated by

total spring-back of Silflex once load is removed. Elastic is also indicated by an essentially linear stress-strain curve, while plastic deformation or permanent deformation is indicated by a more crooked plot as opposed to more linear.

### **Visual Sample Observations**

If Silflex deforms up to the load limit chosen in a linear (elastic) fashion when the load and caster are removed, there would be no permanent depression formed in the Silflex sample's surface. Were there permanent deformation, an examination would show a lasting depression in the surface.

If either one or both edges of any caster or the "blades" of steel flooring cut the Silflex, it would be easily detected visually by taking the suspect surface and bending in an attempt to approach a 90% curvature. The cut surface will "open" to show its gash. Each sample was checked this way after each test. Results of the "cutting test" will be discussed in the observations section that follows.

### **Observations and Conclusions**

- 1) 2" wide commercial casters of both iron and polyurethane, when loaded in compression on solid steel backing against four different compositions /combinations of Silflex having a 0.125" thick yellow silicone surface layer did not cut or permanently distort.
- 2) Due to the elastomeric nature of silicone-based Silflex platform shielding , the depressed contact region of casters and Silflex when under load return to its original planar surface with no divots occurring when load is removed.
- 3) When Silflex was backed by steel during loading, statement 1) and 2) above were true. In no cases did the wheels' edges cut the Silflex.
- 4) When open steel grating comprising rectangles 4" x 1" was used as backing for load testing, "blades" of the open grating were noted to cut the back surface of Silflex. This problem can be avoided by placing a thin rigid backing layer on top the grating to prevent heavy load (> 1000 pounds) on casters from pushing Silflex into grating openings.
- 5) If Silflex is firmly and continuously backed, at loads of up to 1500 pounds per wheel appeared not to push 6" diameter wheels into Silflex deeply enough to cause a troublesome "rolling resistance" to such wheels. Expect the rolling resistance to be reduced by increasing wheel diameter.

## TEST Loads (pounds) for Silflex Block - Caster Combinations

### Set 1 Solid Steel Platform

	<u>8" Polymer</u>	<u>6" Polymer</u>	<u>8" Iron</u>	<u>6" Iron</u>
Block 2	523	997	1014	1512
Block 3	1773	1511	1524	1506
Block 1	1662	1506	1509	1507
Block 4	1500	1507	1508	1506

### Set 2 Steel Grating

Used 8" Iron Caster on all Grating

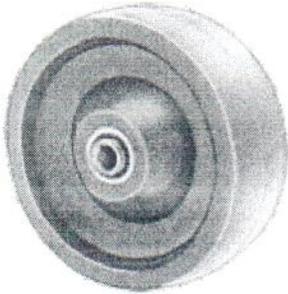
		Damage
Block 2	2534	Cut
Block 3	1007	Cut

**McMASTER-CARR** OVER 555,000 PRODUCTS

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(404) 349-9091 (fax)  
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Text 50479

**Nonmarking Polyurethane Wheel**  
6" x 2", 1/2" Axle, Roller Bearing, 1200 lb Capacity

In stock  
\$36.29 Each  
2472T97



Wheel	
Diameter	6"
Width	2"
Axle Diameter	1/2"
Hub Length	2 7/16"
Capacity Each	1,200 lbs.
Additional Specifications	General Purpose Bearings

Polyurethane is wear resistant like plastic yet is quieter and more resilient. Wheels resist oil, grease, and mild acids and can be steam cleaned. They are extra hard (80D durometer) and nonmarking. Temperature range is -40° to 230° F.

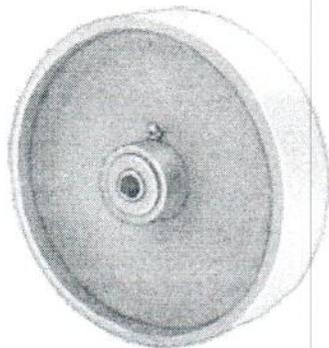
General purpose bearings have straight rollers that provide smooth rolling.

(404) 346-7000  
 (404) 349-9091 (fax)  
 atl.sales@mcmaster.com  
 Text 50479

## Long-Lasting Iron Wheel

Roller Bearing, 6" x 2" Wheel, 1/2" Axle, 1300 lb Capacity

In stock  
 \$31.04 Each  
 2305T42



Wheel	
Diameter	6"
Width	2"
Axle Diameter	1/2"
Hub Length	2 7/16"
Capacity Each	1,300 lbs.
Additional Specifications	Standard with General Purpose Bearings

Rugged cast iron wheels offer the strength and wear resistance you need for heavy loads and long life. Standard—Also known as gray iron. Wheels are solid, unless noted. Temperature range is -20° to 250° F. General purpose bearings have straight rollers for smooth rolling.



6" POLYMER

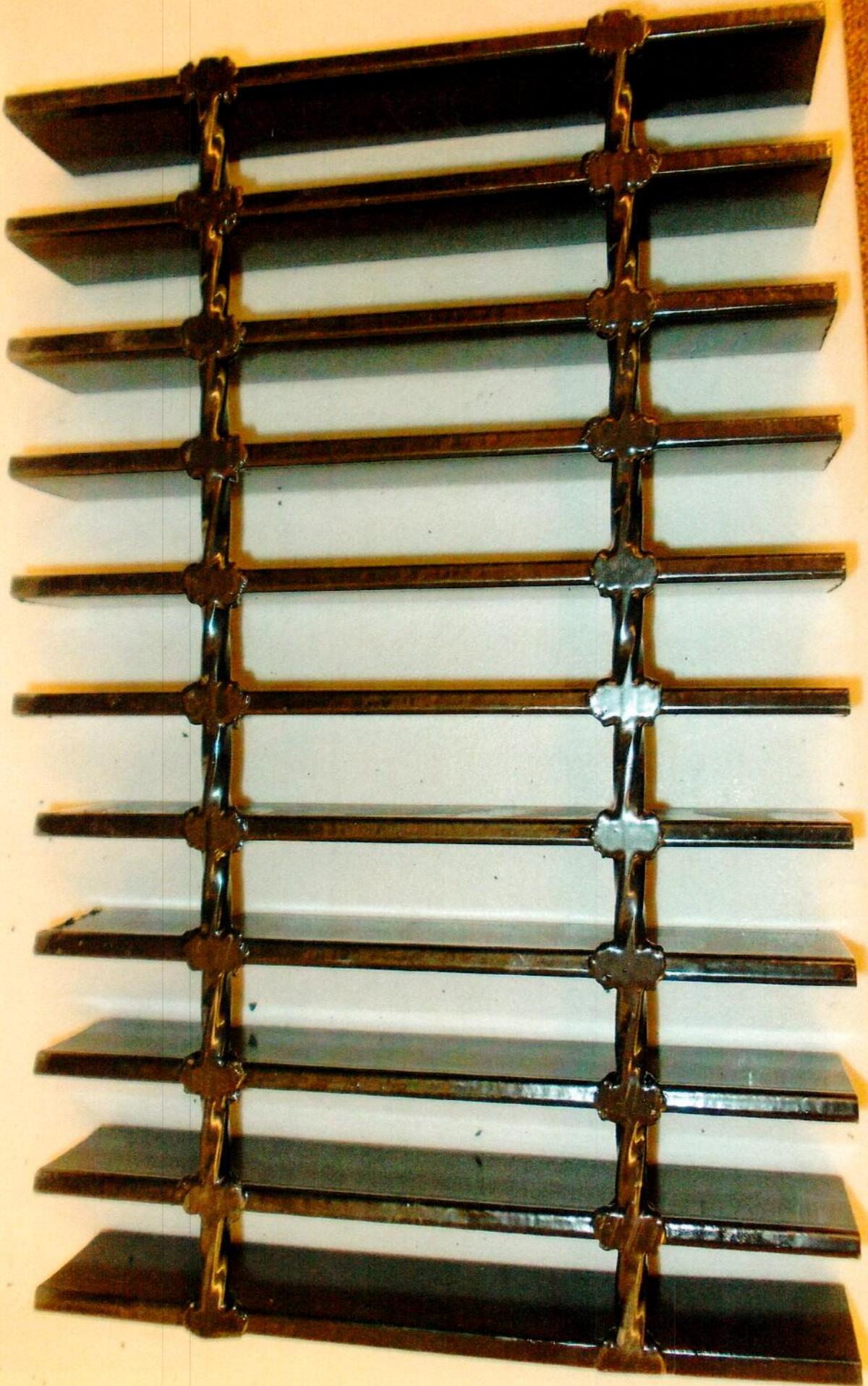


8" Polymer



100% AAD Polymer





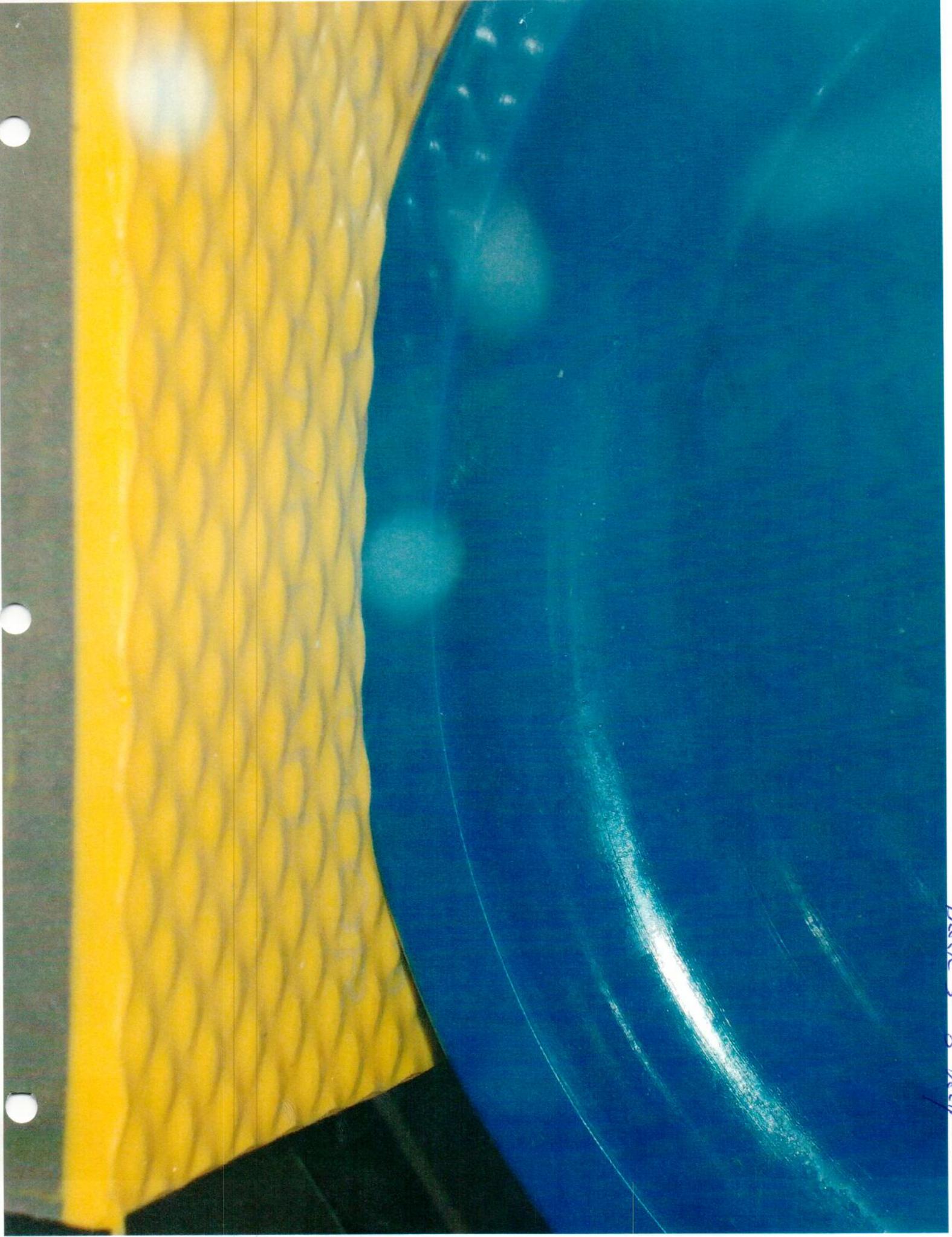
STEEL GRATINGS



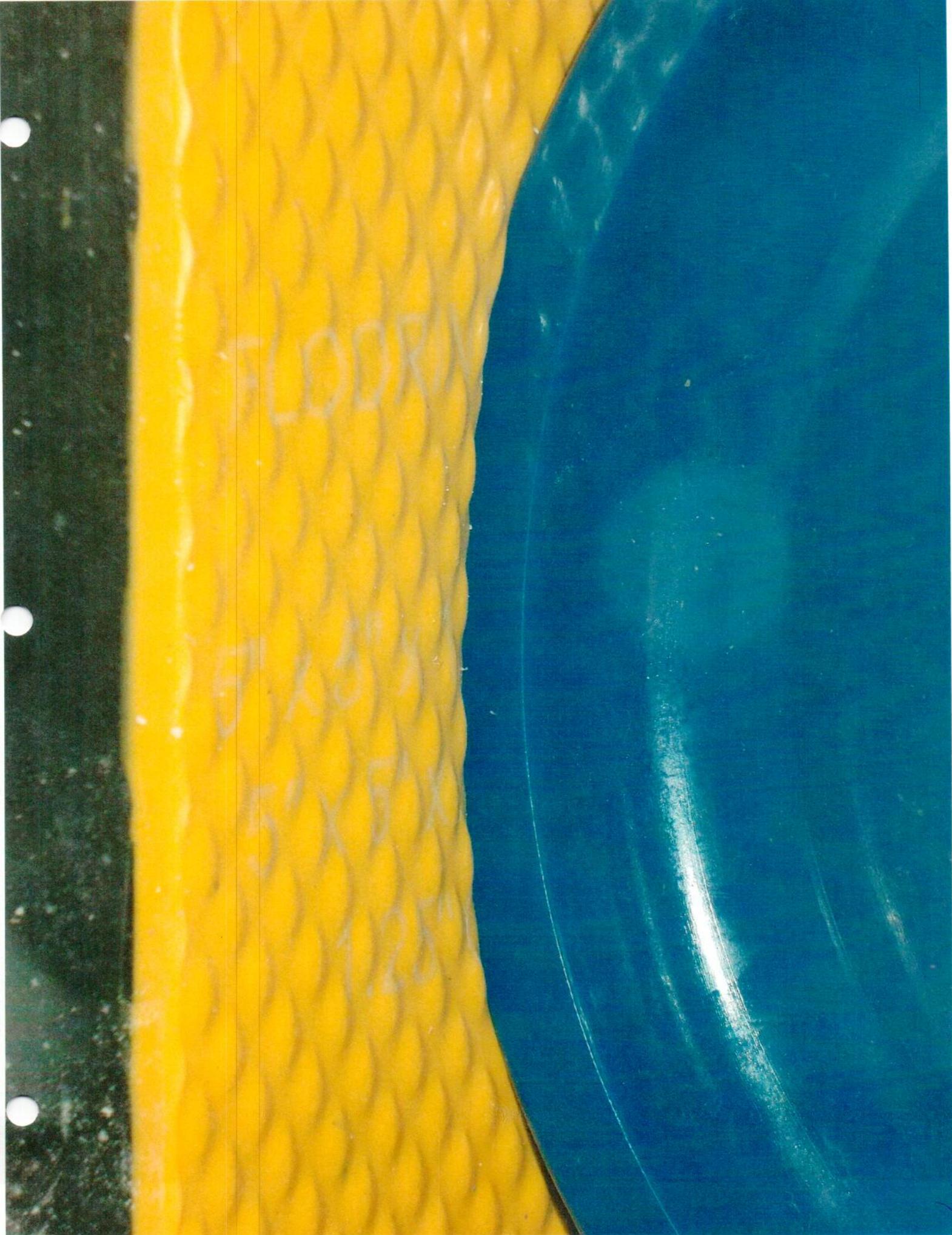
6" 150V



INSTORAD SETUP



Block 3 8" Rally

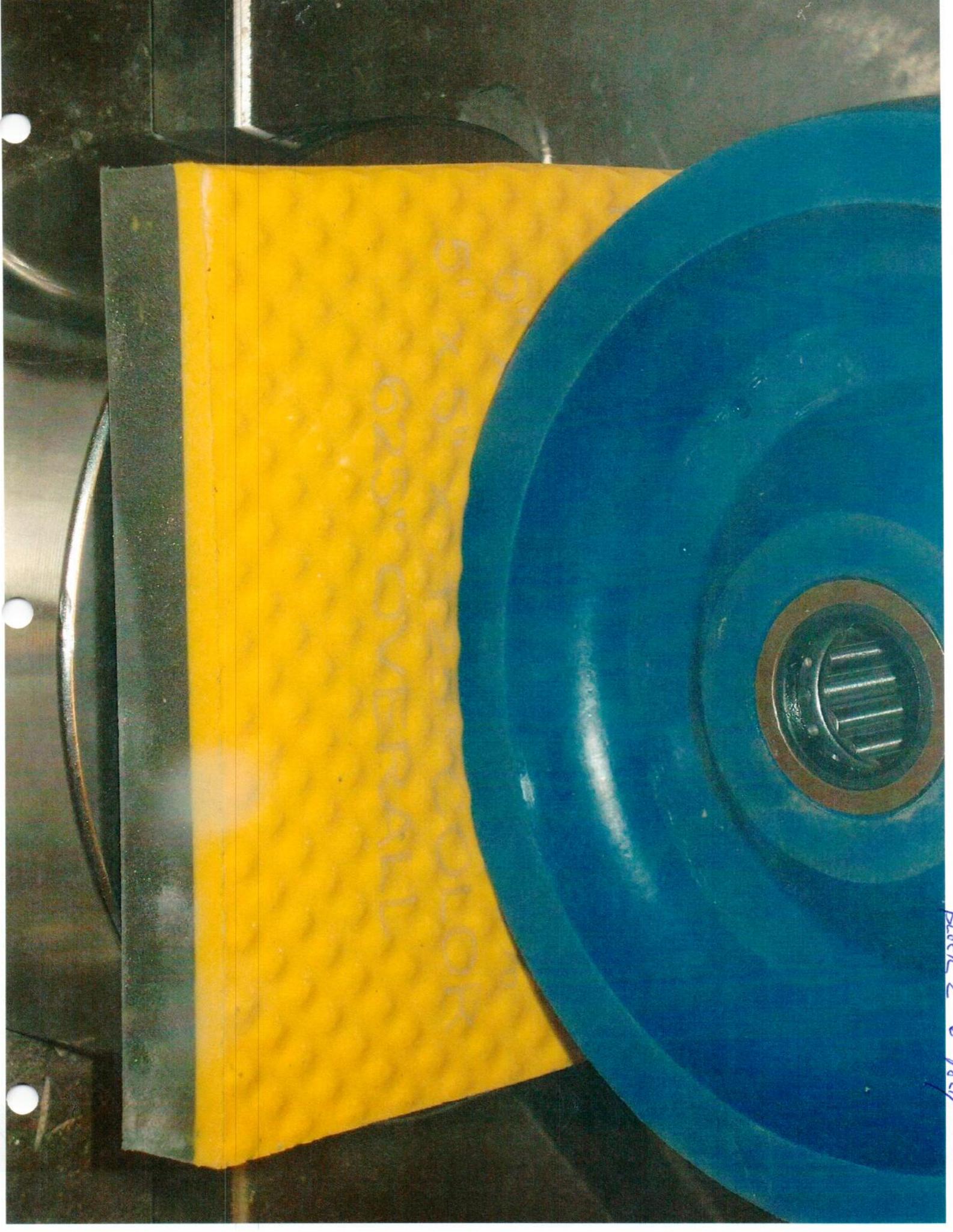


Block 1 81Rly

Block 4 8" Rcy



Block 4 8" Rcy



Block 2 6" Poly -



Black 3 6" Poly



Block 1 G'RLY



5" x 15" OVERALL

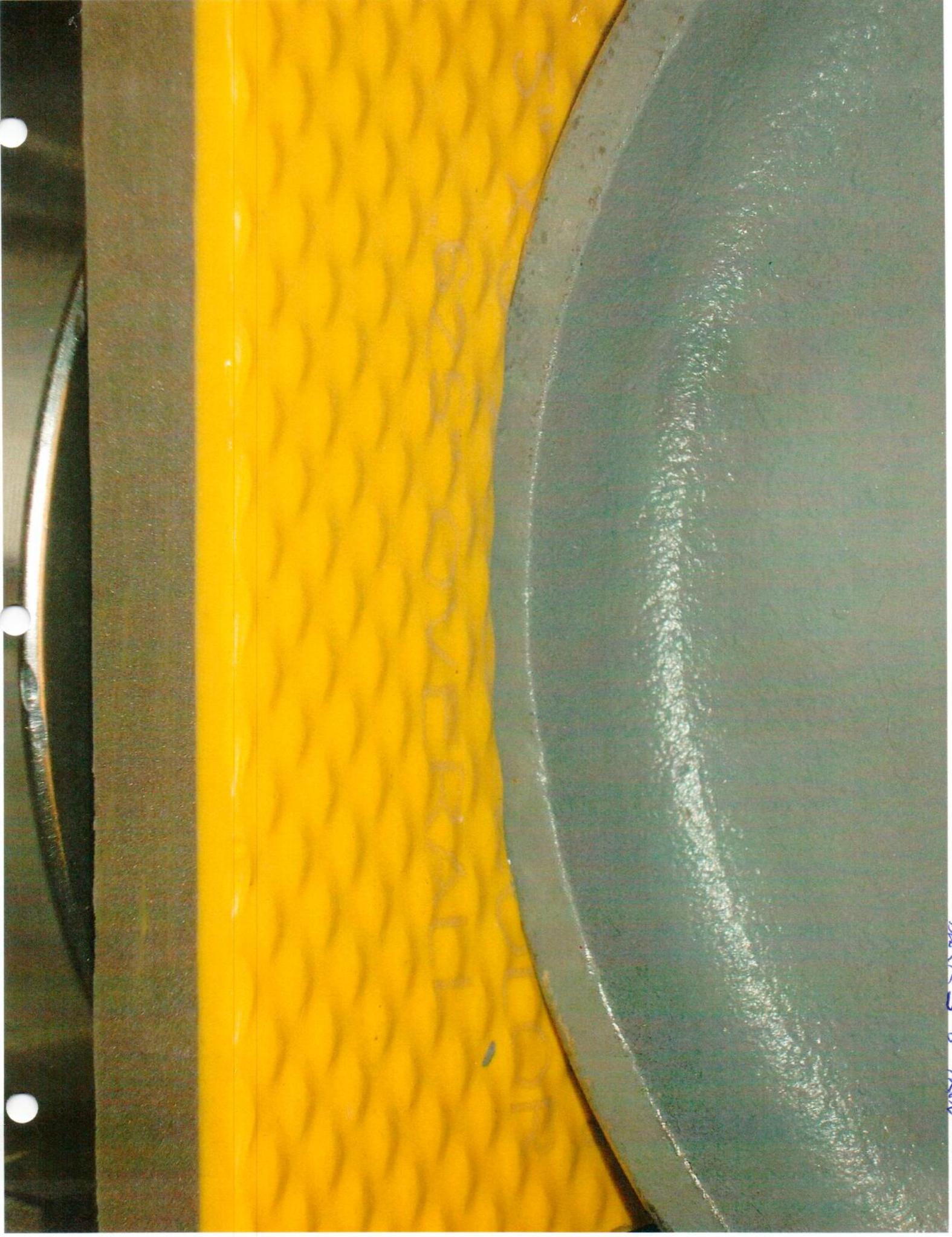
5" 5" 5"

Block 4 6" Poly

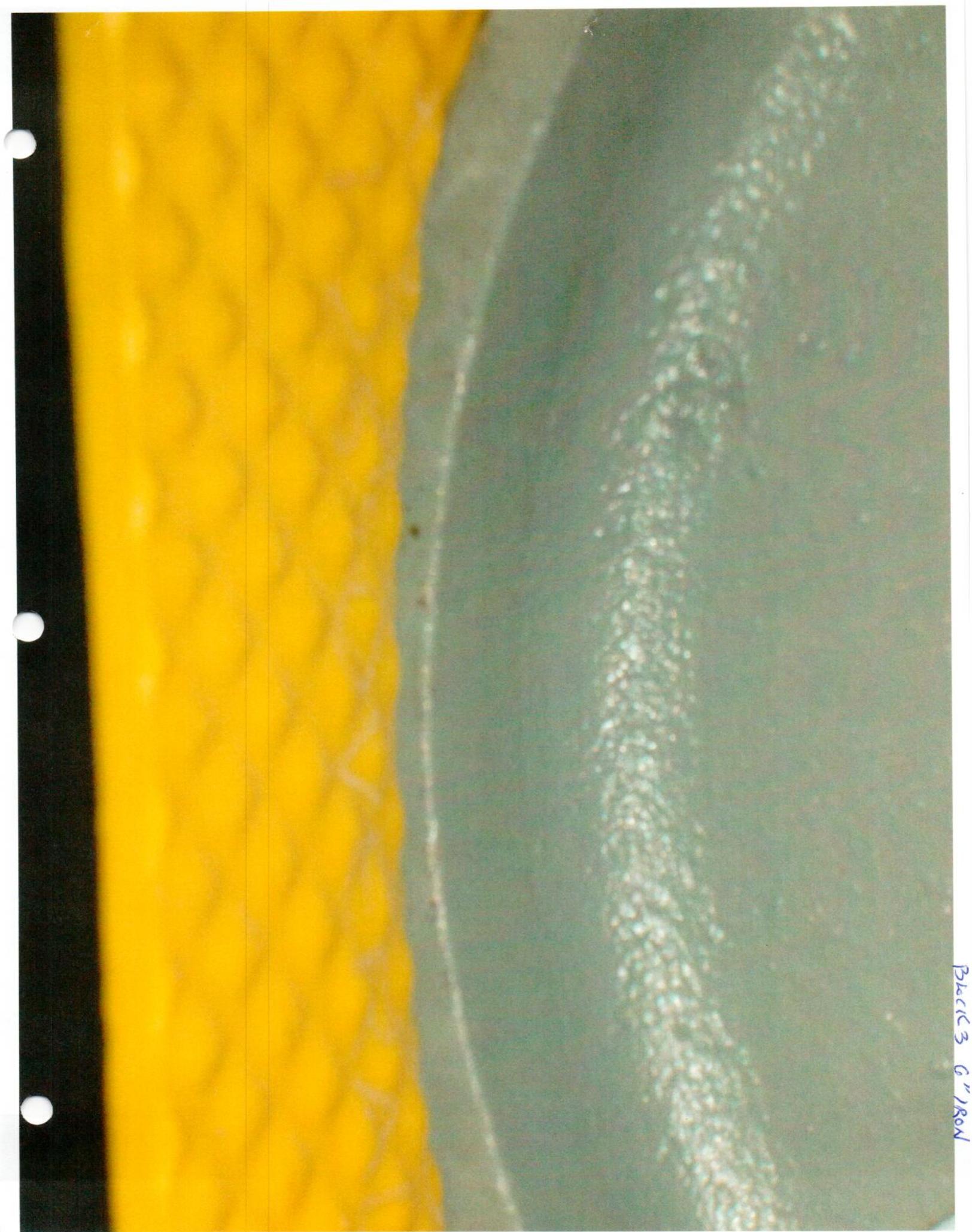


Bloc/C 2 8" / 180N

Plastics 3 8" 180V



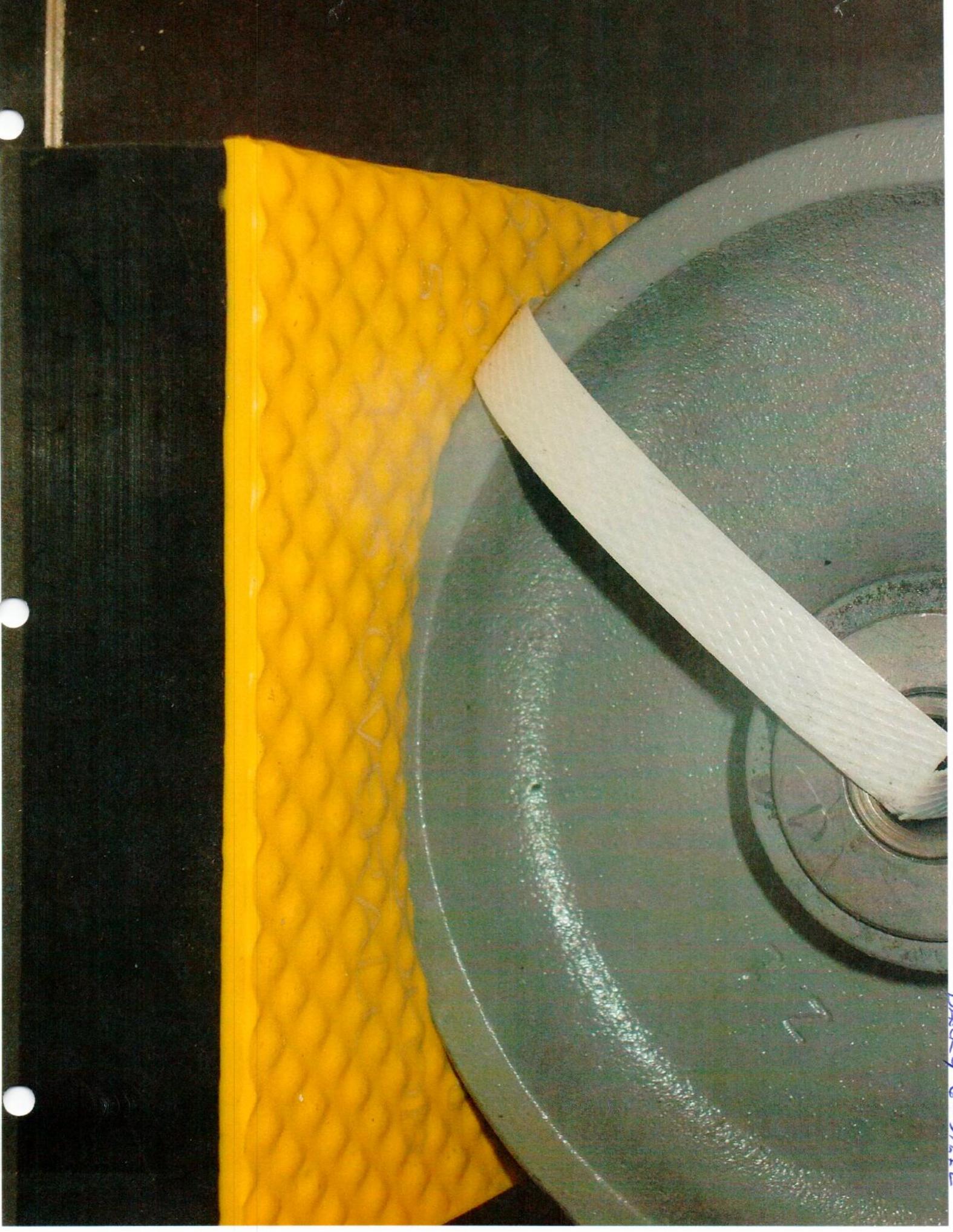
Basic 8" Row



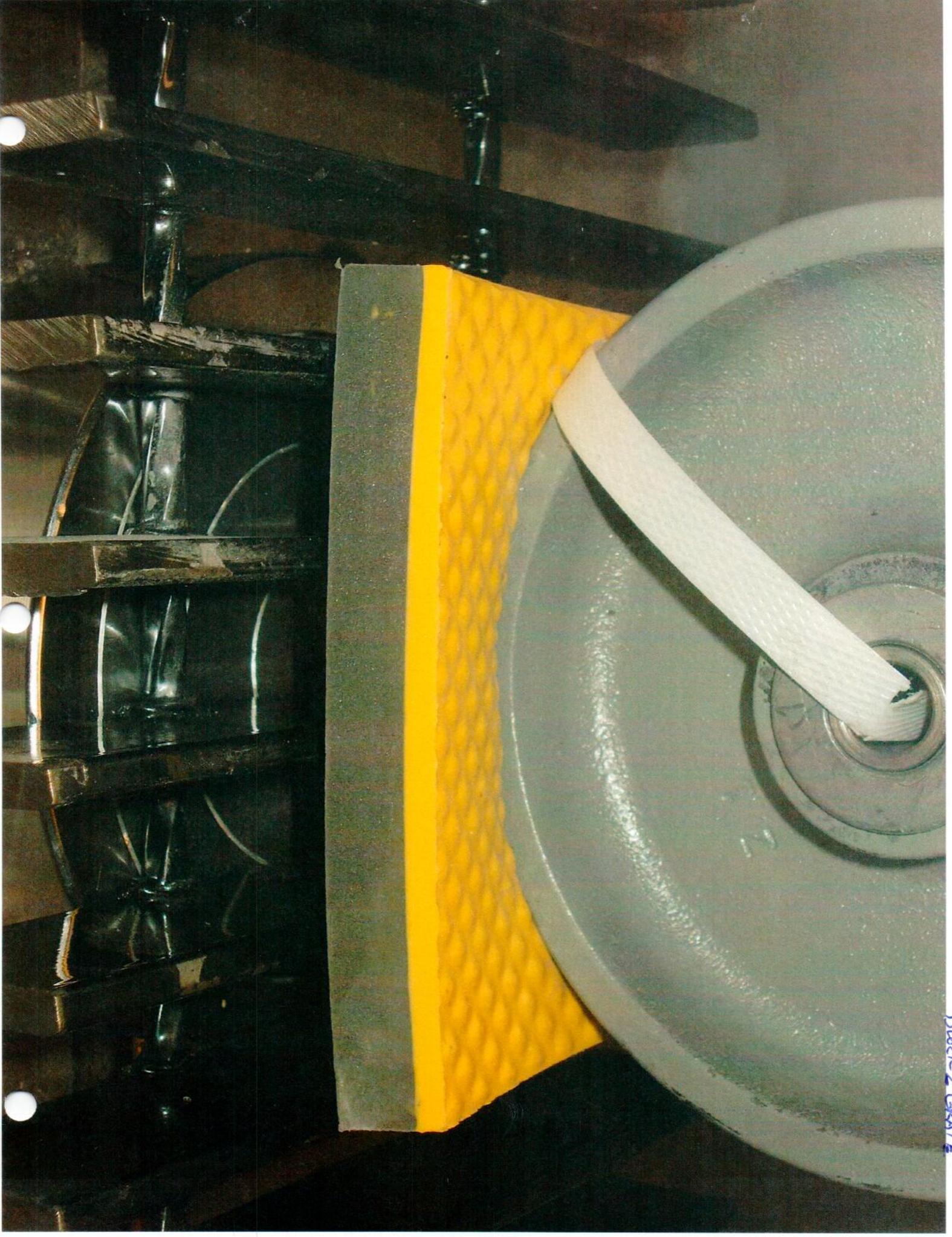
Black 3 G" 180N



Black 1 6" Rod



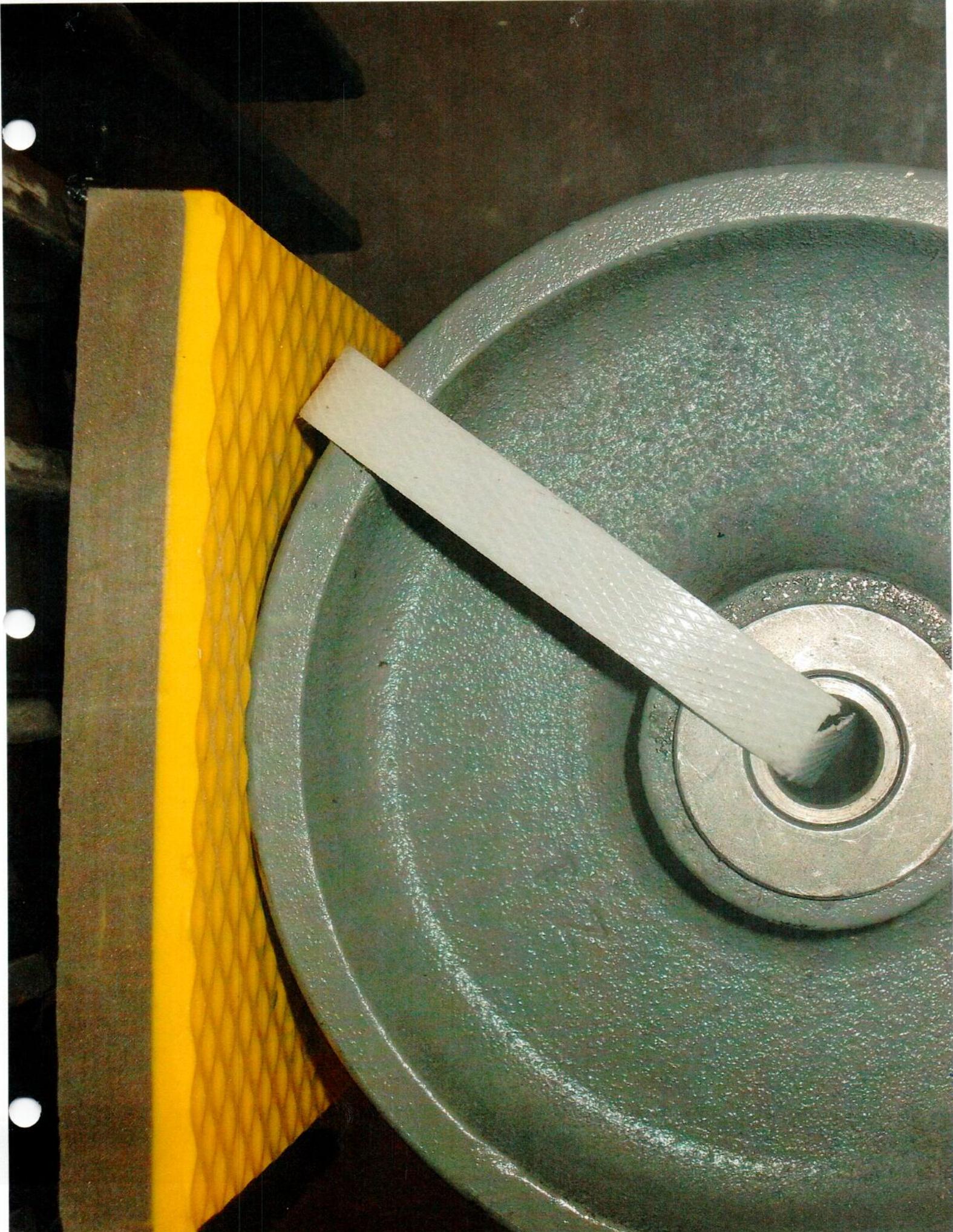
Black 4 C" STEEL



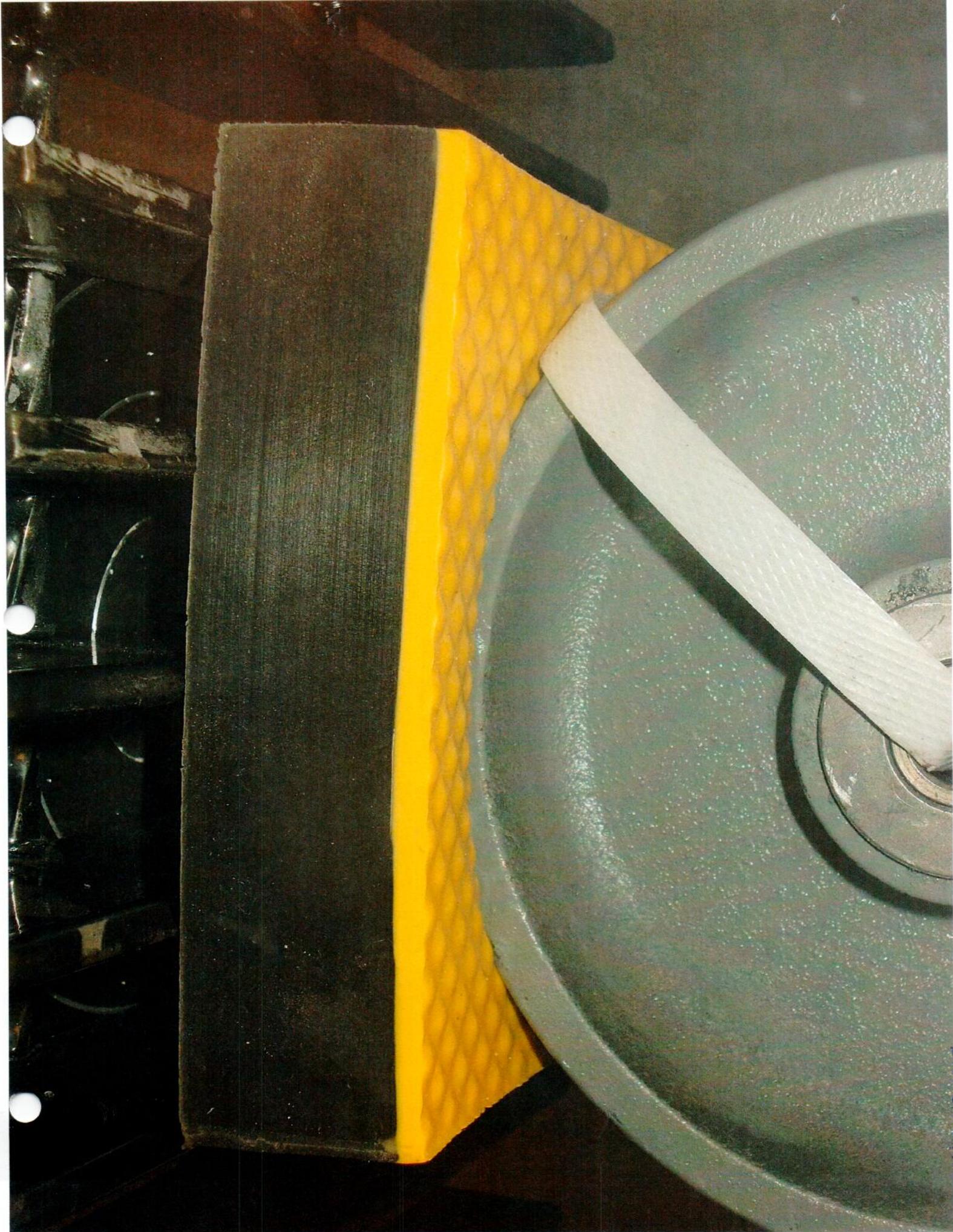
Block 2 GRATE

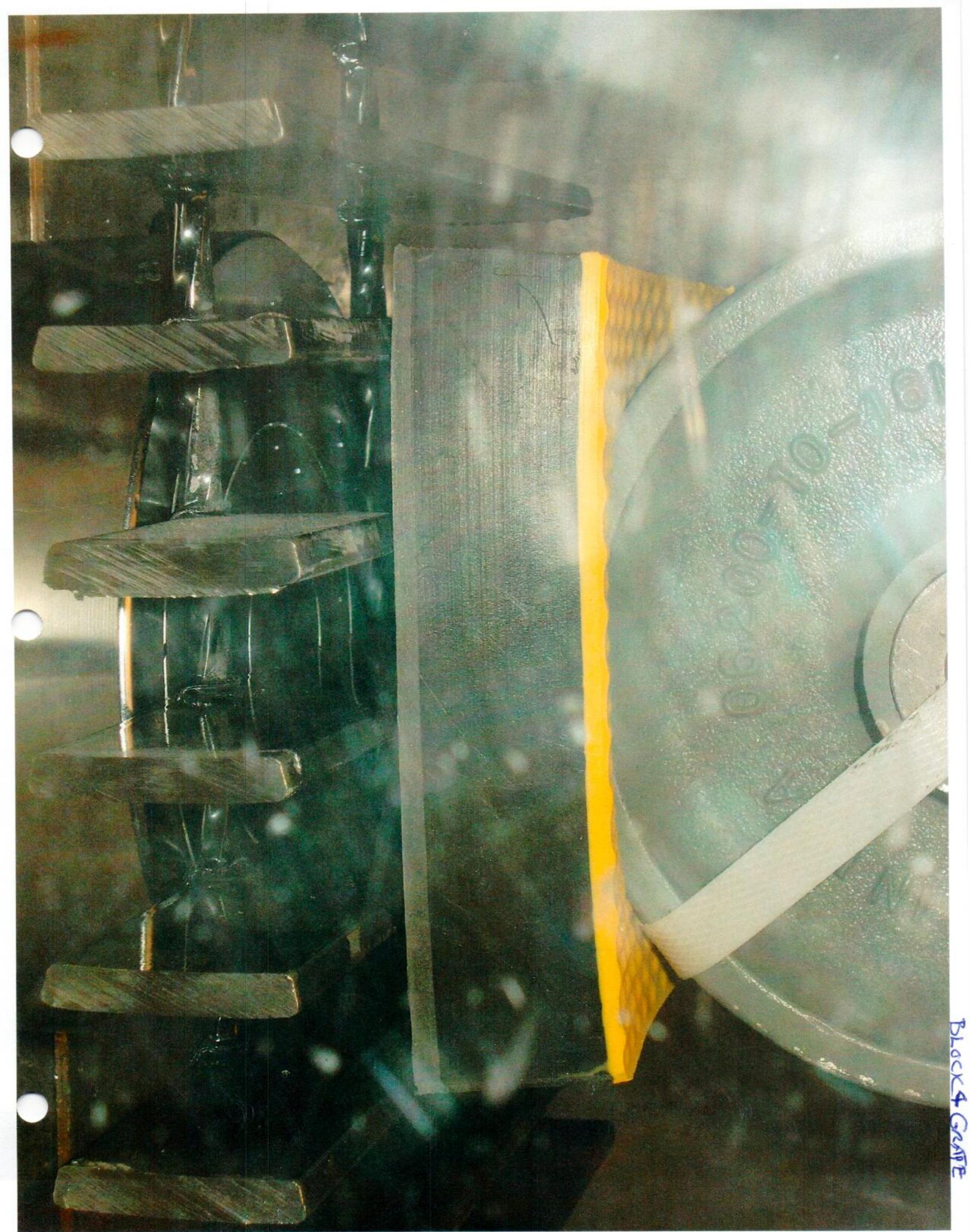


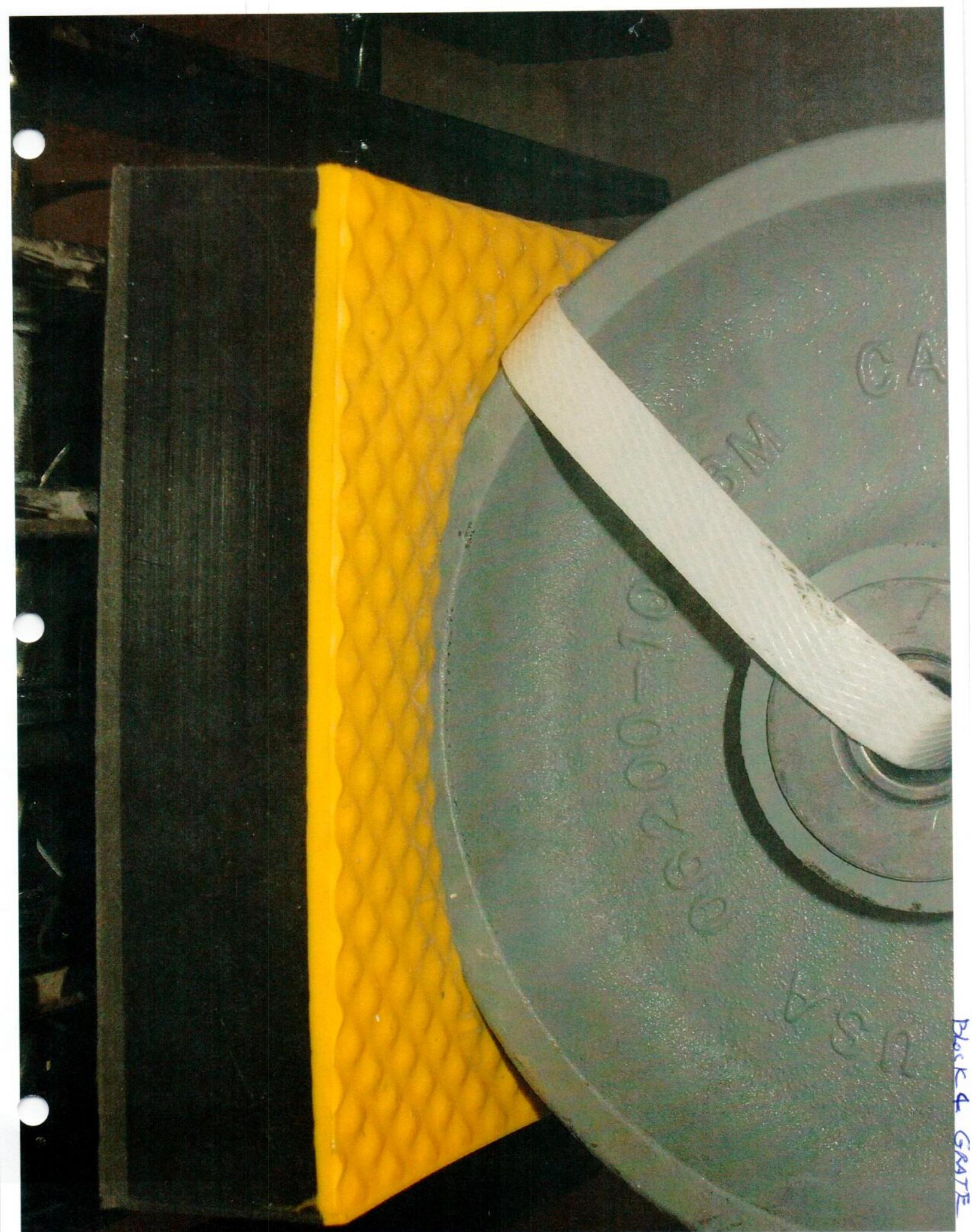
Block 2 GATE



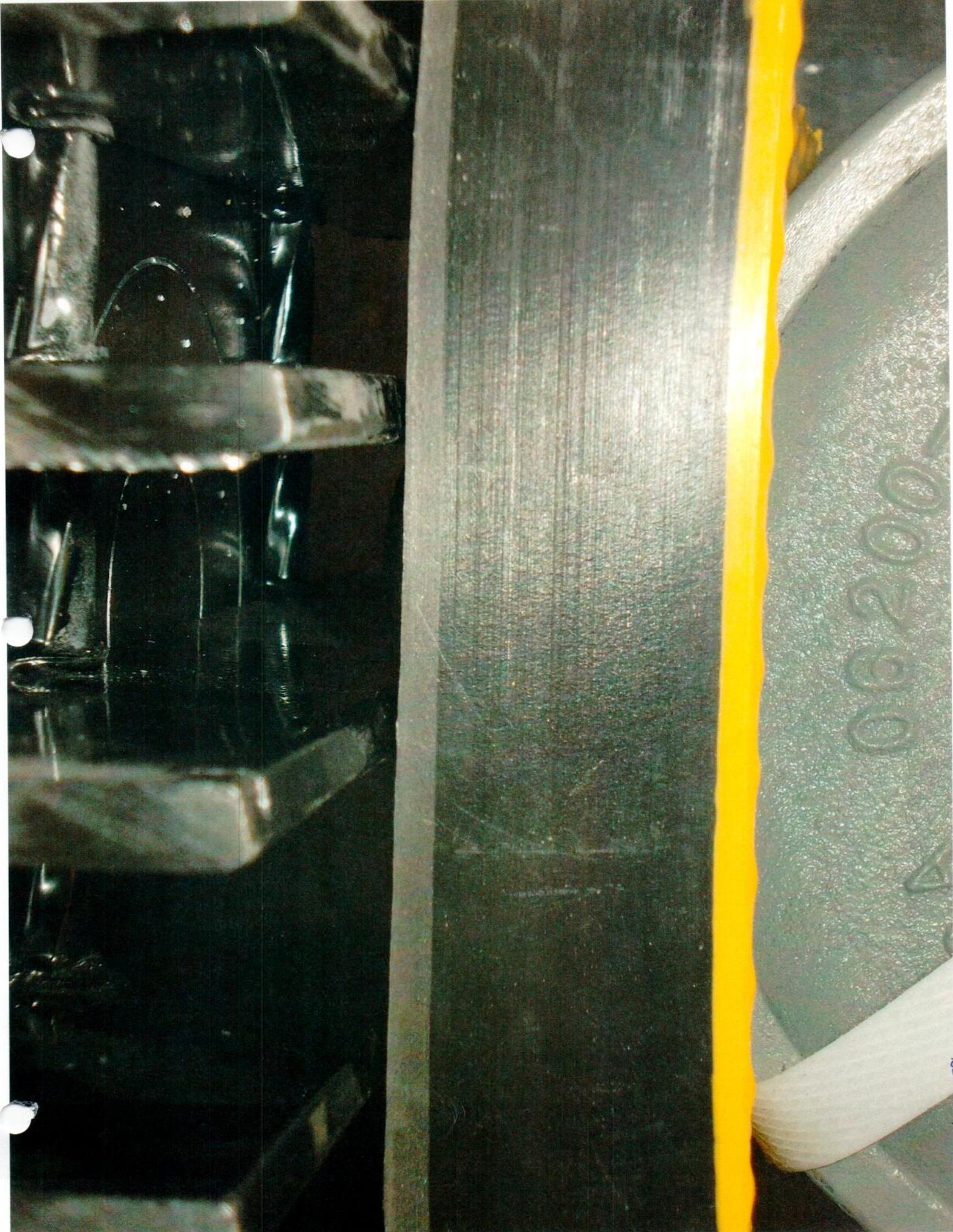
3/24/03 GRT/TE







Block 4 GRATE



Block 4 GRATE

**Tile Council of North America  
100 Clemson Research Blvd.  
Anderson, SC 29625**

**Sample ID: TCNA-140-16 .is\_comp**

Method description

118.4 cube compressive strength

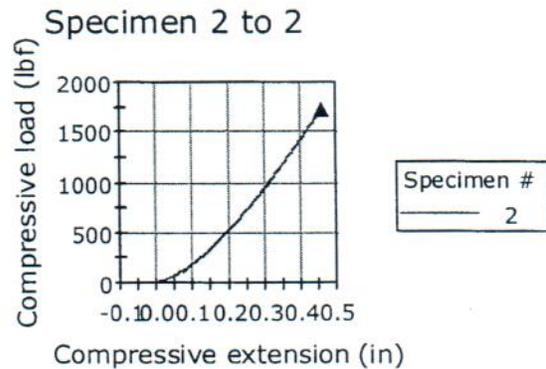
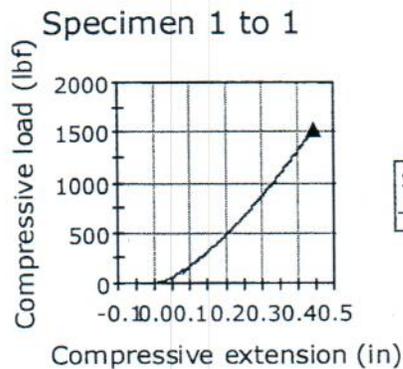
Date of Last Specimen Tested: Wednesday, March 09, 2016

Sample Information

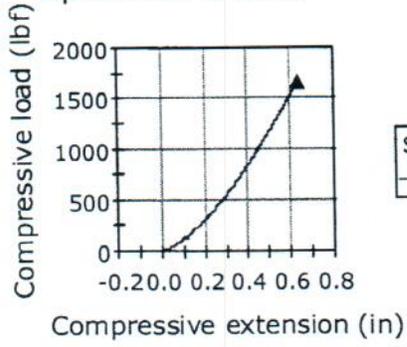
Test Report Number	TCNA-140-16
Technician	NCM
Test Subject Material ID	Series 1 - 8" Polymer Wheel
Cure Parameter	As received
Specimen label	Series 1 - 8" Polymer Wheels
Comments	Block 2 Block 3 Block 1 Block 4

Results

	Max. Load (lbf)	Extension at Maximum Compressive load (in)
1	1523.31812	-0.447
2	1713.87746	-0.461
3	1662.11773	-0.637
4	1491.86086	-0.582
Mean	1597.79354	-0.532

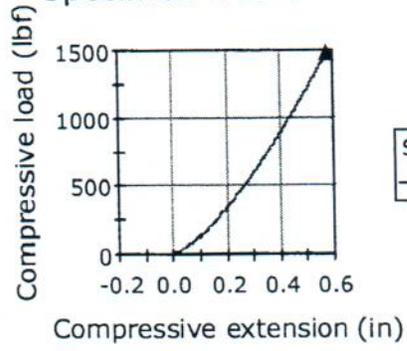


Specimen 3 to 3



Specimen #  
3

Specimen 4 to 4



Specimen #  
4

**Tile Council of North America  
100 Clemson Research Blvd.  
Anderson, SC 29625**

**Sample ID: TCNA-140-16\_2.is\_comp**

Method description

118.4 cube compressive strength

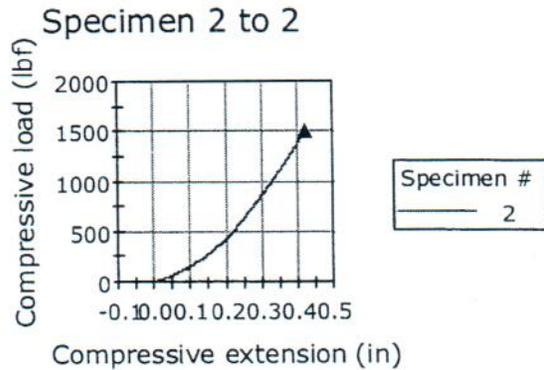
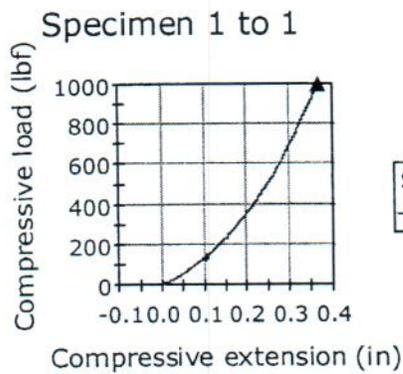
Date of Last Specimen Tested: Wednesday, March 09, 2016

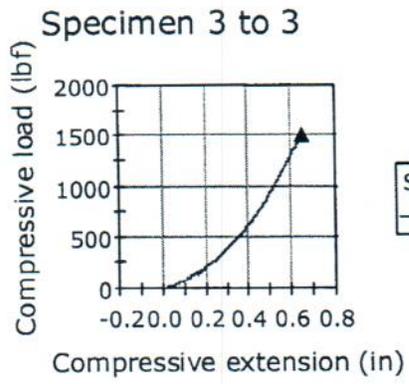
Sample Information

Test Report Number	TCNA-140-16
Technician	NCM
Test Subject Material ID	Series 2 - 6" Polymer Wheel
Cure Parameter	As received
Specimen label	Series 2 - 6" Polymer Wheels
Comments	Block 2 Block 3 Block 1 Block 4

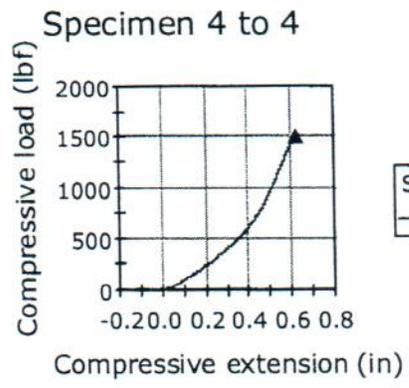
Results

	Max. Load (lbf)	Extension at Maximum Compressive load (in)
1	996.84522	-0.368
2	1511.03964	-0.426
3	1505.76677	-0.655
4	1507.36081	-0.623
Mean	1380.25311	-0.518





Specimen #  
3



Specimen #  
4

**Tile Council of North America**  
**100 Clemson Research Blvd.**  
**Anderson, SC 29625**

**Sample ID: TCNA-140-16\_3.is\_comp**

Method description

118.4 cube compressive strength

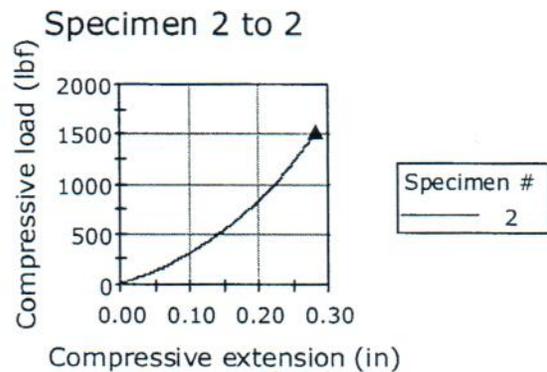
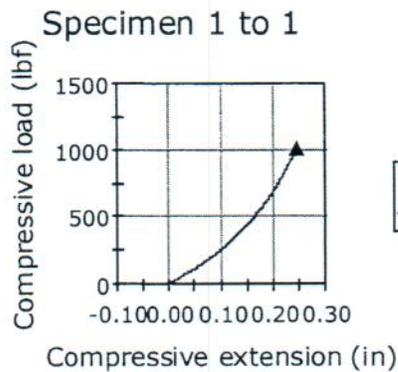
Date of Last Specimen Tested: Wednesday, March 09, 2016

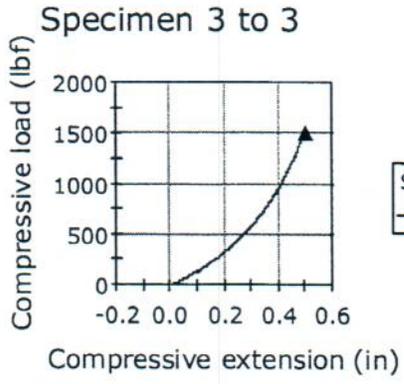
Sample Information

Test Report Number	TCNA-140-16
Technician	NCM
Test Subject Material ID	Series 3- 8" Steel Wheels
Cure Parameter	As received
Specimen label	Series 3 - 8" Steel Wheels
Comments	Block 2 Block 3 Block 1 Block 4

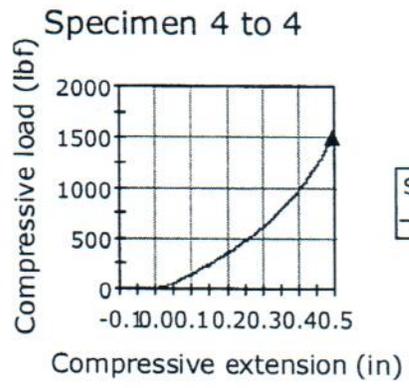
Results

	Max. Load (lbf)	Extension at Maximum Compressive load (in)
1	1014.27691	-0.248
2	1523.84322	-0.285
3	1508.92438	-0.502
4	1508.36756	-0.497
Mean	1388.85302	-0.383





Specimen #  
3



Specimen #  
4

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**Anderson, SC 29625**

**Sample ID: TCNA-140-16\_4.is\_comp**

Method description

118.4 cube compressive strength

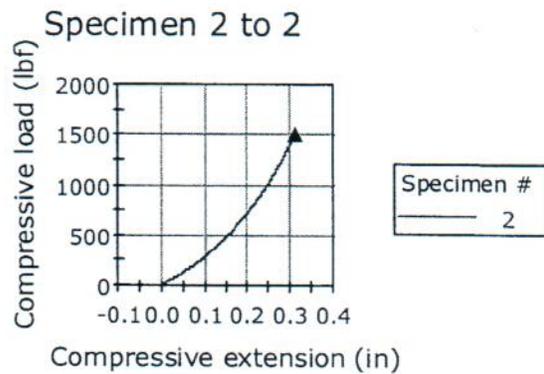
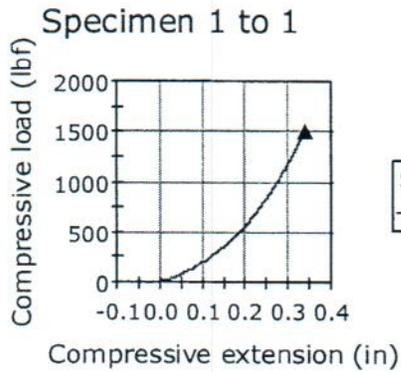
Date of Last Specimen Tested: Wednesday, March 09, 2016

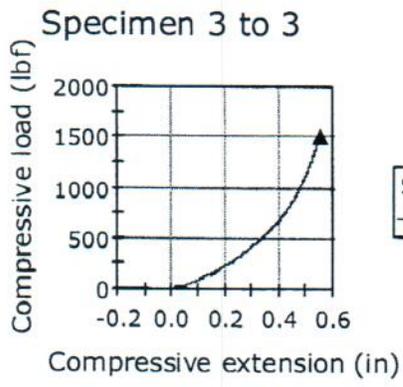
Sample Information

Test Report Number	TCNA-140-16
Technician	NCM
Test Subject Material ID	Series 4- 6" Steel Wheels
Cure Parameter	As received
Specimen label	Series 4 - 6" Steel Wheels
Comments	Block 2 Block 3 Block 1 Block 4

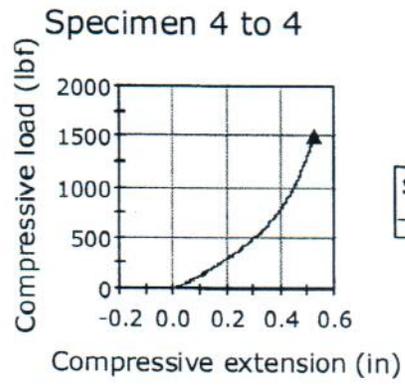
**Results**

	Max. Load (lbf)	Extension at Maximum Compressive load (in)
1	1512.44639	-0.343
2	1507.18713	-0.314
3	1507.34018	-0.557
4	1506.49611	-0.531
Mean	1508.36746	-0.436





Specimen #  
3



Specimen #  
4

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Anderson, SC 29625**

**Sample ID: TCNA-140-16\_5.is\_comp**

Method description

118.4 cube compressive strength

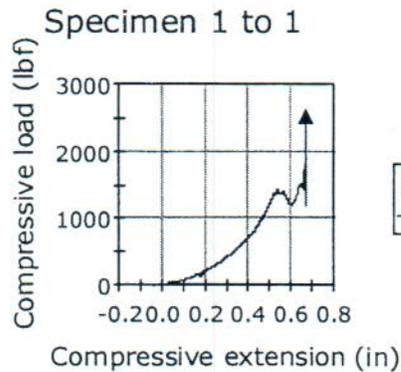
Date of Last Specimen Tested: Wednesday, March 09, 2016

Sample Information

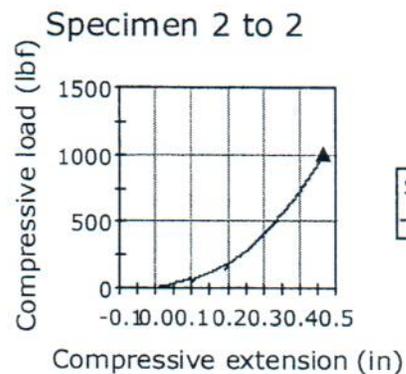
Test Report Number	TCNA-140-16
Technician	NCM
Test Subject Material ID	Series 4- 6" Steel Wheels w/metal grate
Cure Parameter	As received
Specimen label	Series 4 - 6" Steel Wheels w/metal grate
Comments	Block 2 Block 3 Block 1 Block 4 Block 4 1500

Results

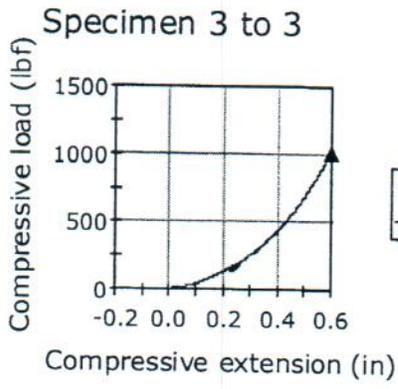
	Max. Load (lbf)	Extension at Maximum Compressive load (in)
1	2535.58488	-0.677
2	1007.22419	-0.470
3	1006.99441	-0.600
4	1006.15159	-0.596
5	1461.74220	-0.704
Mean	1403.53946	-0.610



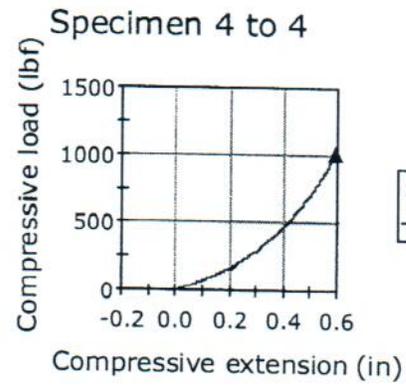
Specimen #  
1



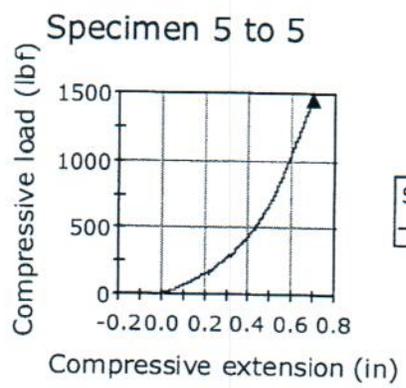
Specimen #  
2



Specimen #  
3



Specimen #  
4



Specimen #  
5